

*ESTABLISHING FIVE DERIVED MANDS IN  
THREE ADOLESCENT BOYS WITH AUTISM*

CAROL MURPHY AND DERMOT BARNES-HOLMES

NATIONAL UNIVERSITY OF IRELAND, MAYNOOTH

Three 14-year-old boys with diagnoses of autism learned to mand for the delivery or removal of tokens by presenting nonsense syllables (A<sub>1-5</sub>, respectively). A match-to-sample procedure was used to establish conditional discriminations between the 5 A stimuli and 5 B stimuli and between the B stimuli and 5 C stimuli. Subsequently, each participant was able to use the C stimuli to mand, illustrating a transfer of function, although 1 participant first required multiple-exemplar training.

*Key words:* autism, derived mands, emergent relations, language

Skinner's (1957) behavioral account of language has utility for teaching language in applied settings. Nevertheless, it may be useful to supplement this approach with relational frame theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001), because unlike Skinner's work, the latter focuses almost exclusively on verbal behavior that does not occur via direct contingencies of reinforcement (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). Combining these two approaches may lead to the development of practical teaching applications that shift the language learner from direct contingency-based language skills to derived, emergent, or generative verbal abilities (Murphy, Barnes-Holmes, & Barnes-Holmes, 2005).

Previous studies established untrained manding in children with autism (Murphy & Barnes-Holmes, 2009a, 2009b; Murphy et al., 2005). The study by Murphy et al. involved derived

manding by children with autism for the addition of single tokens, and a follow-up study (Murphy & Barnes-Holmes, 2009a) involved derived manding for the addition or removal of a single token. A subsequent study (Murphy & Barnes-Holmes, 2009b) showed derived manding for more or fewer tokens of various amounts with typically developing children. The current study aimed to replicate a demonstration of derived manding with adolescents with autism and to extend the research by increasing the complexity of derived manding with these participants.

## METHOD

*Participants and Setting*

Participants were three 14-year-old boys who had been diagnosed with autism by an independent clinical psychologist. Each boy attended a remedial educational unit attached to a school for typically developing boys. Each participant had a verbal repertoire that included several hundred mands, tacts, and intraverbals. None of the boys used the picture exchange communication system (PECS) or augmentative language devices. None had been exposed previously to matching-to-sample (MTS) procedures involving arbitrary stimuli, but all had had extensive MTS training throughout schooling. The experiment was conducted at a desk in the boys' regular classroom by an investigator who remained unaware of the objectives of the study.

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All correspondence should be addressed to Carol Murphy at the Department of Psychology, National University of Ireland Maynooth, County Kildare, Ireland (e-mail: Carol.A.Murphy@nuim.ie).

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*Materials.* Fifteen nonsense syllables (A<sub>1-5</sub>: *cug, vek, eif, tib, rav*; B<sub>1-5</sub>: *bot, sia, yor, zuf, xum*; and C<sub>1-5</sub>: *sab, oun, mer, ama, niz*) were printed on colored laminated cards and used for mand training and conditional discriminations. For each occasion of transfer training, we used five additional nonsense syllables (D<sub>1-5</sub>: *iri, mub, per, ece, fal*; E<sub>1-5</sub>: *xes, rae, caz, miq, wul*; F<sub>1-5</sub>: *kee, lic, got, ast, pio*; and G<sub>1-5</sub>: *nie, bem, ruf, loa, ict*).

During mand training and testing, a board-game format was used to create a motivating operation for manding in that (a) obtaining more or fewer tokens was reinforcing dependent on board-game presentations, and (b) the board game evoked behavior with a prior history of producing the required reinforcers. The rectangular board (30 cm by 20 cm) had a center panel outlined in black that contained six circles for token placement. The tokens were 8-cm disks with printed smiley faces.

#### *Dependent Measures*

During test trials, two observers independently recorded the mand stimulus presented by participants by writing the nonsense syllable (e.g., *sab*) on separate score sheets that were later compared on a trial-by-trial basis for interobserver agreement. Agreement for each test was calculated by dividing the total number of agreements by the total number of agreements (both observers scored the same mand stimulus) and disagreements (observers scored different mand stimuli), and this ratio was converted to a percentage. Agreement was 100% across all test trials for all participants. No interobserver agreement or procedural integrity data were collected during training trials.

#### *Procedure*

*Mand training.* A board-game format (Murphy et al., 2005) was designed to create an establishing operation to evoke manding for more or fewer tokens to achieve six tokens (i.e., one token in each slot with no empty slots) on the board. The investigator presented four to eight tokens on the board and an array of mand

stimulus cards (A<sub>1-5</sub>) placed in random order approximately 12 cm below the token board (Figure 1, top) on each trial. Participants had to mand for -2 (i.e., remove 2), -1, 0, +1, or +2 (i.e., add 2) tokens by presenting A1, A2, A3, A4, or A5, respectively. Correct responses resulted in a change in the token arrangement as requested, praise or corrective feedback, and points toward winning the game. The mastery criterion for mand training was 22 of 25 correct responses for two successive blocks.

*Conditional discrimination training.* When participants had completed mand training with the A stimuli successfully, we used MTS training to establish conditional discriminations with the A stimuli and other nonsense syllables (e.g., A1-B1, A2-B2). On each trial, the investigator positioned an A stimulus as a sample on the desk in front of the participant, approximately 14 cm above five comparisons (B<sub>1-5</sub>) arranged in random order. The investigators used positive reinforcement and corrective feedback to teach participants to match stimuli by selecting (e.g., "Look here [A1], point here [B1]"; see Figure 1, middle). The mastery criterion for A-B training was 22 of 25 trials correct for two successive blocks before proceeding to a second set of conditional discriminations with the B stimuli and five additional C stimuli (e.g., B1-C1, B2-C2).

*Test for derived mands.* After successful conditional discrimination training, participants were exposed to a test for five derived mands. Using the board-game format, participants could mand for -2, -1, 0, +1, or +2 tokens with C1, C2, C3, C4, and C5, respectively (Figure 1, bottom). To control for possible learning effects, these selection responses did not result in delivery or removal of tokens (i.e., extinction). Performance at 90% correct across two 20-trial blocks was considered evidence of derived mands. Participants were not explicitly made aware of the criterion and were told that they had done well regardless of performance. If unsuccessful, the participant

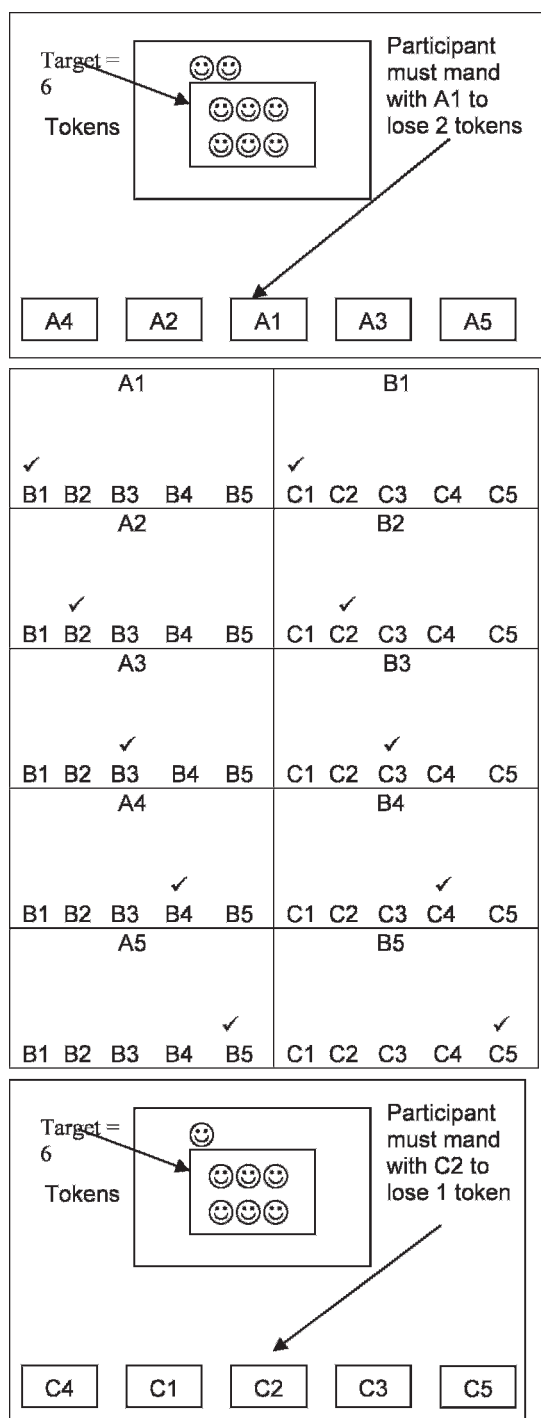


Figure 1. Schematic representation for mand training (top), conditional discrimination training (middle), and a test for five derived mands (bottom).

underwent a repeated sequence of multiple-exemplar training followed by a test with novel stimuli until he demonstrated a criterion performance. During multiple-exemplar training, the investigator provided reinforcement for mands with the C stimuli (i.e., tokens, feedback, points) followed by training in novel discriminations (B–D) and then testing derived mands with the novel (D) stimuli.

## RESULTS AND DISCUSSION

Figure 2 depicts the responses of Mark, Robert, and Darragh. Mark completed mand training in 100 trials (i.e., four 25-trial blocks) and conditional discrimination training in 75 trials (i.e., three 25-trial blocks). He subsequently showed all five derived mands. Robert required 150 trials for mand training and appeared to have difficulty scanning more than three stimuli. He acquired the discriminations when all five stimuli were presented in three-item arrays but made more errors when four or five stimuli were presented. He eventually reached the performance criterion with five-item arrays and then progressed through training, mastering each relation in two 25-trial blocks. During the five-item array test trials for derived mands, his initial performance was poor (i.e., 36% correct), although he showed all five derived mands when subsequent trials were conducted with four-item arrays (90% correct).

Darragh required 75 trials to complete mand training and 150 trials to complete conditional discrimination training, but subsequently he performed poorly on the test for derived mands (i.e., 48% correct). Previous research has shown that multiple-exemplar training facilitates derived manding (Murphy et al., 2005); therefore, Darragh underwent this training. The procedures did not involve tests for equivalence relations prior to the test for derived mands, which may have been relevant to his poor test performance. It is possible that initial trained relations had weakened when the tests were conducted because time constraints precluded

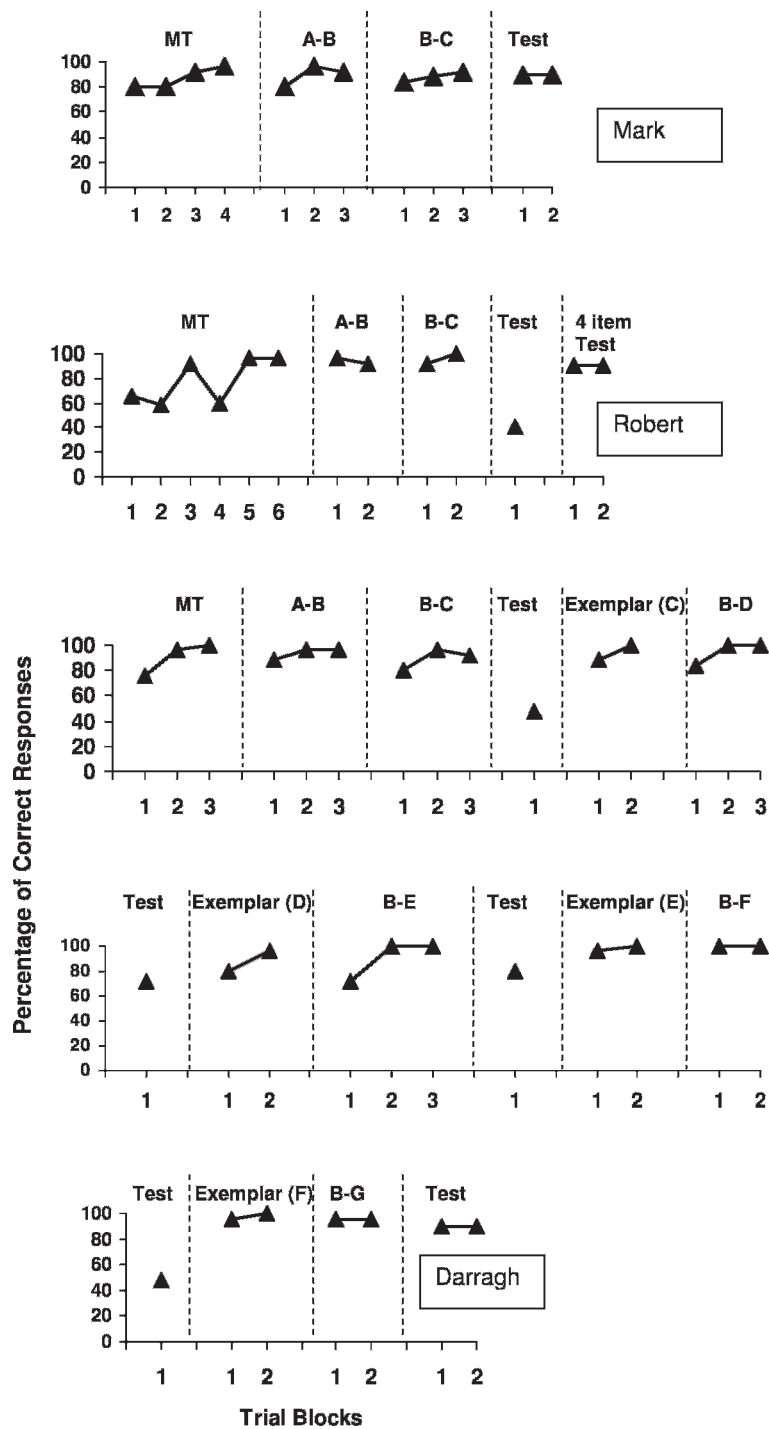


Figure 2. Results for Mark (top), Robert (second), and Darragh (bottom). MT = mand training. A-B, B-C, B-D, B-E, B-F: conditional discrimination training.

checking and retraining procedures. Regardless, multiple-exemplar training appeared to facilitate derived manding for Darragh, an outcome that is consistent with the results of Murphy et al.

A few limitations of the current study are noteworthy. First, the participants were adolescents with relatively advanced verbal repertoires. It is unclear whether these findings would hold true with individuals with lower levels of functioning, although similar studies (Rehfeldt & Root, 2005; Rosales & Rehfeldt, 2007) have demonstrated that derived manding can be established with this population. Second, the board-game format was designed so that absent or surplus tokens would serve to motivate participants to mand for specific reinforcers; however, mand test trials occurred under extinction conditions. It is possible that the prior history of reinforcement for mands resulted in resistance to extinction. It might also be argued that the tokens functioned as a discriminative stimulus to tact the correct answer with a particular card to obtain generalized social reinforcement associated with prior academic training situations (i.e., "It is good to give the right answer"). Therefore, there may have been some functional overlap between manding and tacting in the context of the board game, as so frequently occurs in the natural environment (Skinner, 1957).

In summary, the current report replicated previous research in establishing derived manding in an applied setting and in using multiple-exemplar training to facilitate derived manding that initially failed to emerge. The report extends the literature by examining the next level of complexity in derived manding in adolescents with autism. The clinical importance of emergent mands is intuitive in that a person at this skill level might be expected to

apply alternative mands if and when requests are not reinforced. For example, a child might first request "bigger ice cream," and if this fails, use an equivalent mand such as "more ice cream," followed by a third mand such as, "extra ice cream." However, more extensive investigation is needed to demonstrate this phenomenon empirically.

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